EFFECTS OF REDD INUNDATION RESULTING FROM RESERVOIR FLUCTUATION ON BULL TROUT (*SALVELINUS CONFLUENTUS*) EGG SURVIVAL AND EMERGENCE IN THE CEDAR RIVER WATERSHED, WASHINGTON

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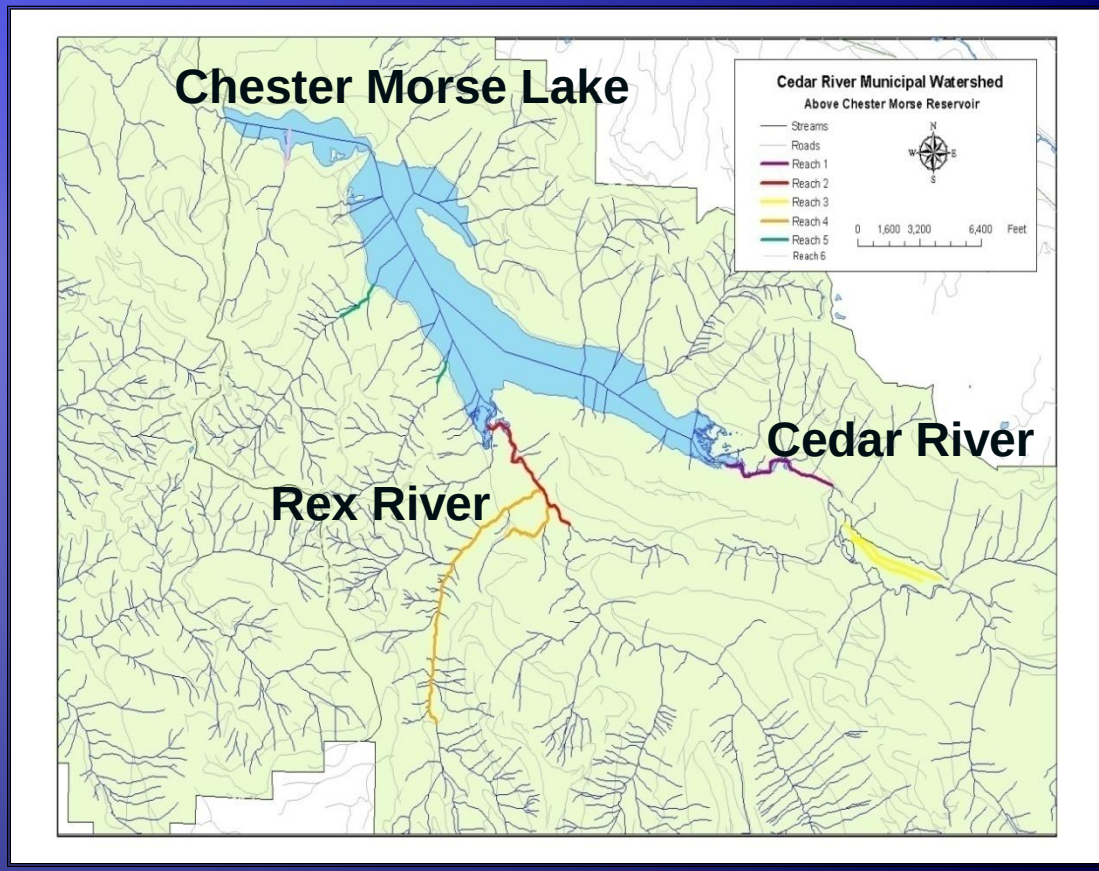
Background

- Chester Morse Lake – major water supply for City of Seattle – also some limited hydropower generation
- Major tributaries – Cedar and Rex rivers



more background

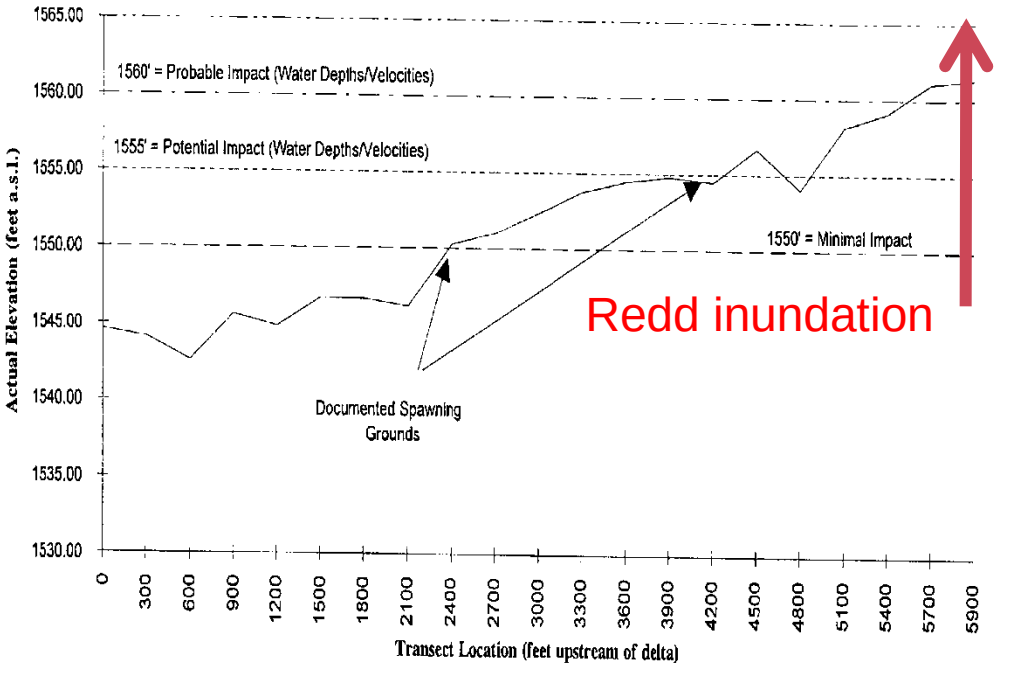
- Cedar watershed supports Adfluvial populations of bull trout ("threatened" under ESA)
- Estimated population

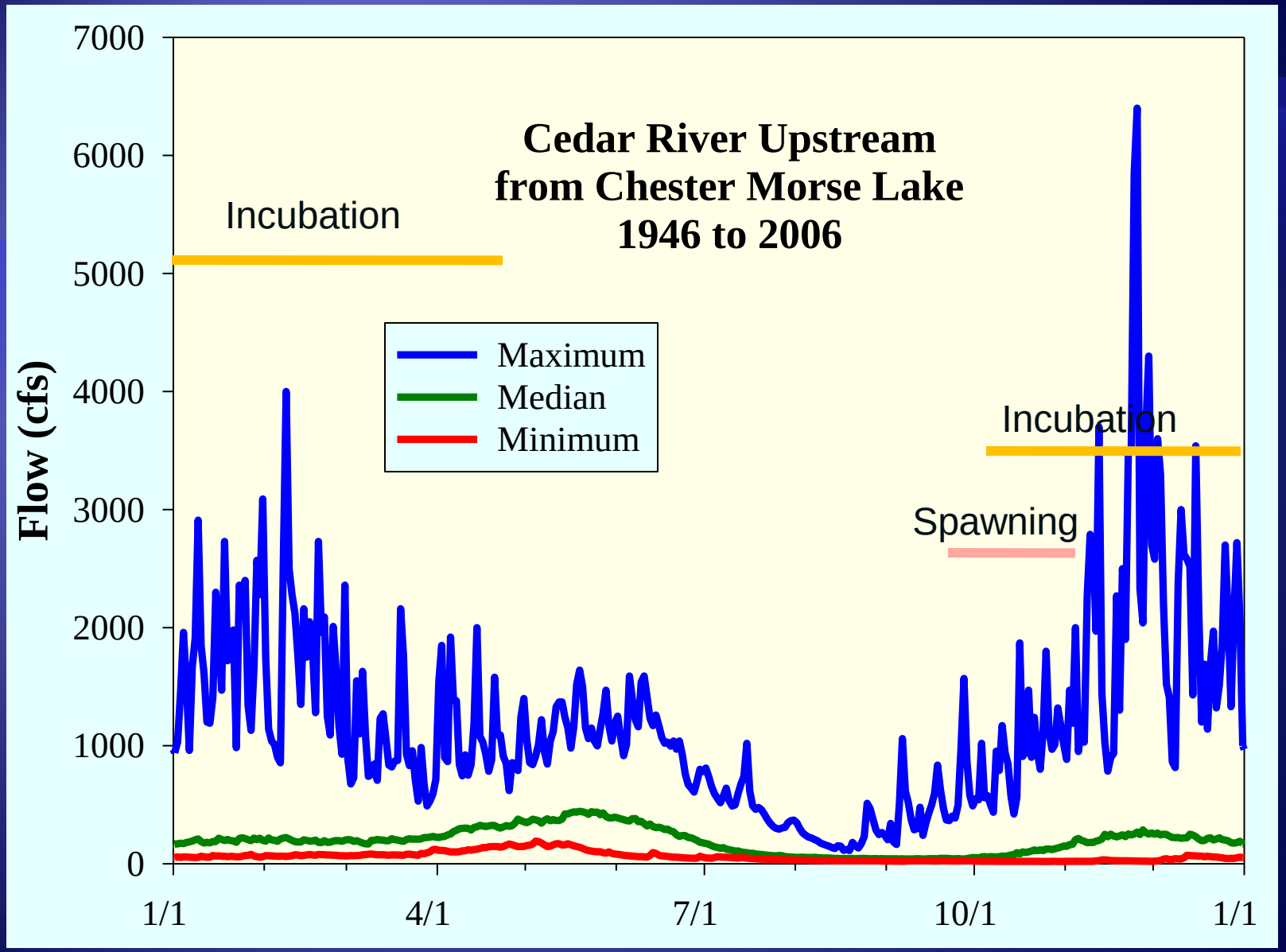
of bull trout: 3100 adults

- Pygmy whitefish (native) and rainbow trout (introduced) also present

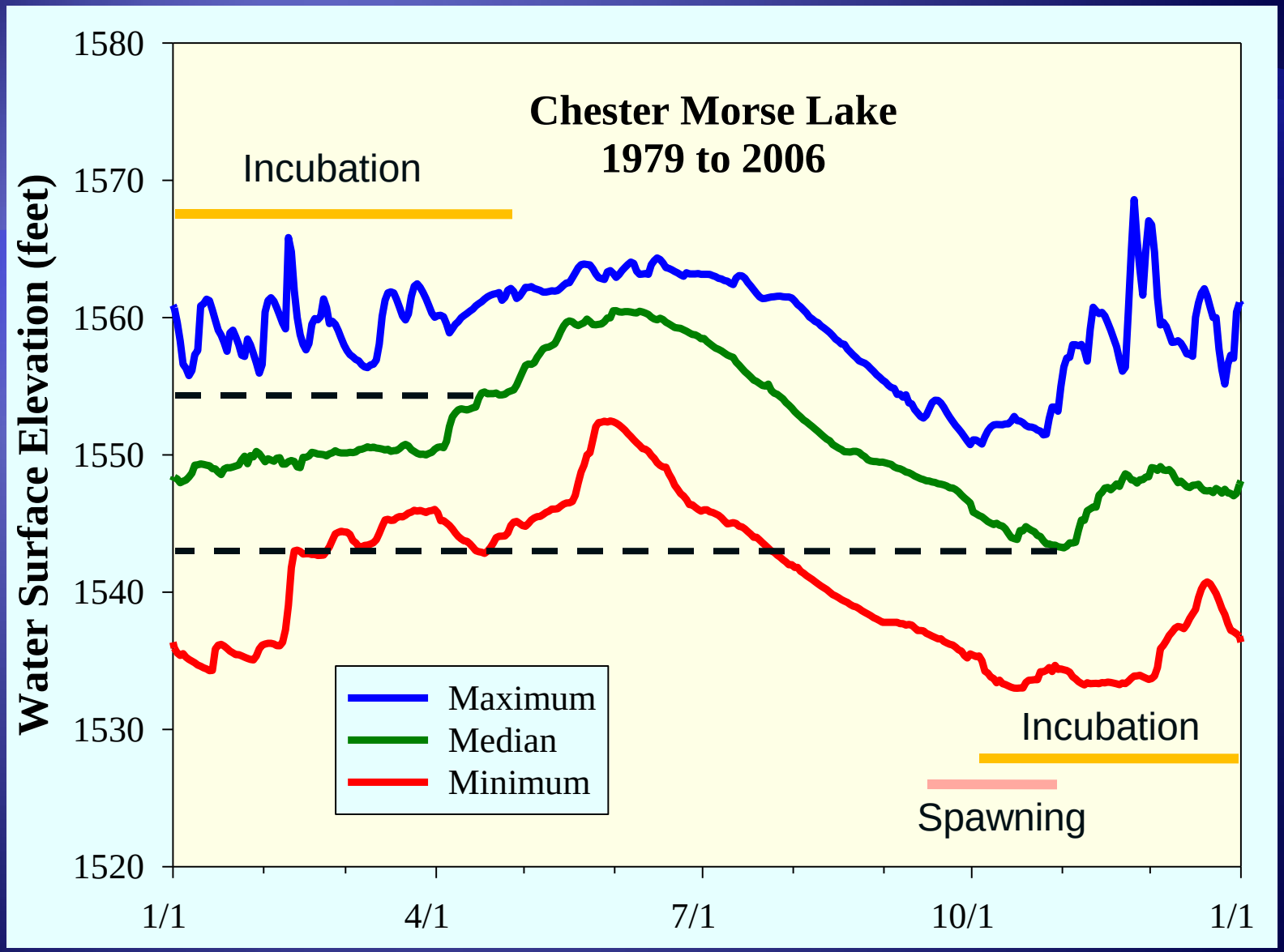
and even more background

- Reservoir levels fluctuate seasonally
- Low levels create riverine habitats in lower reaches of rivers – conducive for spawning
- Higher levels – progressive upstream shift from riverine to lacustrine habitats – potential redd inundation





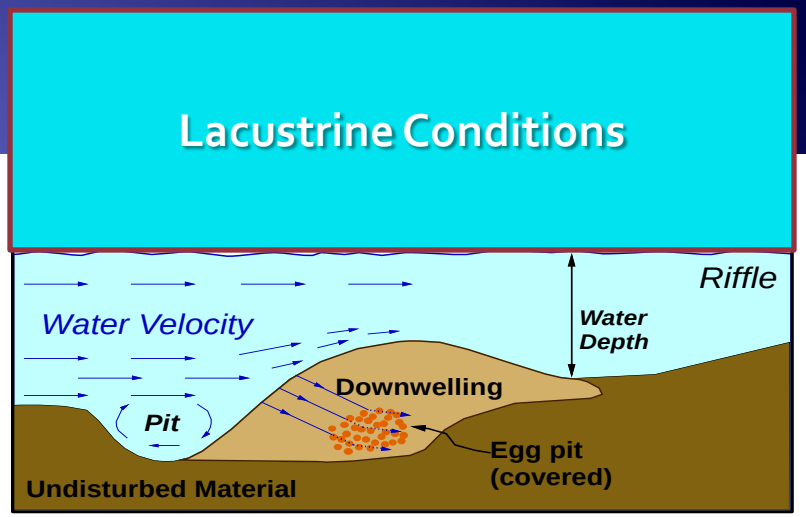
Bull trout spawning on rising limb of hydrograph

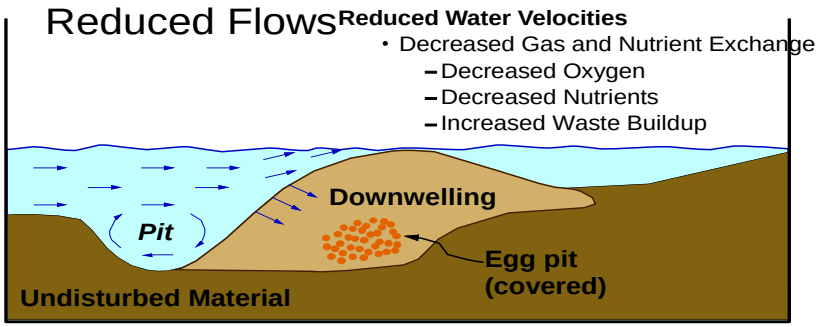


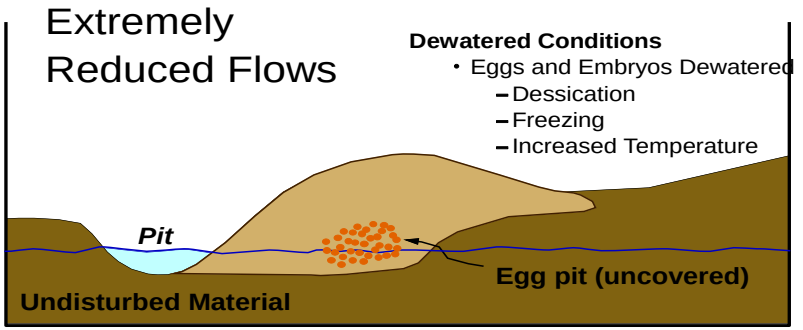
Bull trout spawning when reservoir levels low

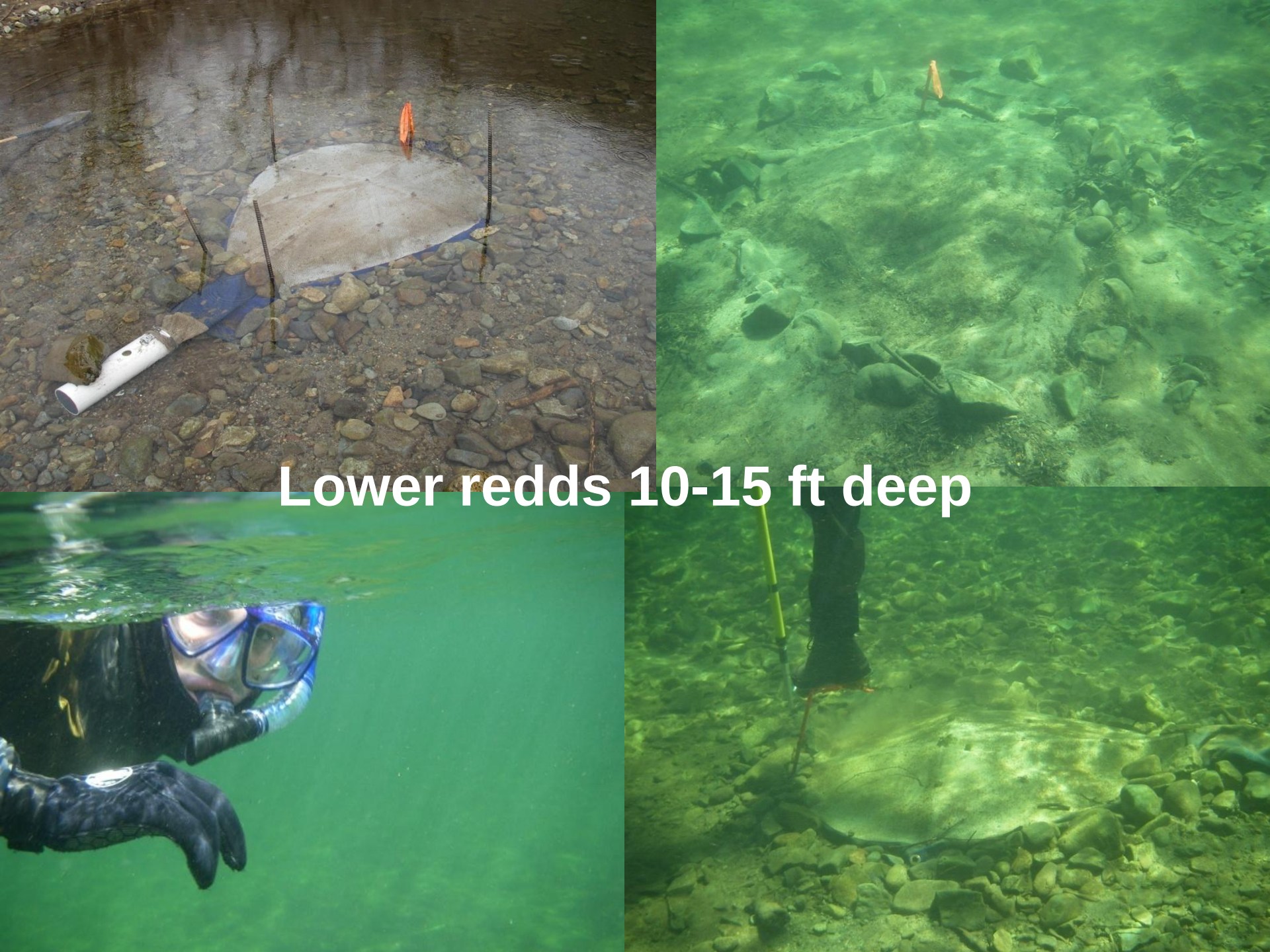
Egg incubation success depends on:

- Suitable depths and velocities
- Intragravel velocities & downwelling
- Clean gravels = low fine sediments (<0.84 mm)
- DO









Lower redds 10-15 ft deep

City of Seattle Multi-species Habitat Conservation Plan -2000

- Assessment of potential bull trout "take" required in HCP

ENDANGERED SPECIES ACT - SECTION 7 BIOLOGICAL OPINION UNLISTED SPECIES ANALYSIS, AND SECTION 10 FINDINGS
for proposed issuance of a Section 10 Incidental Take Permit to the City of Seattle, Seattle Public Utility, for the Cedar River Watershed Habitat Conservation Plan

And so….Study

- Effects of reservoir fluctuations on bull trout spawning and egg survival:
  SPECIFICALLY – effects of redd inundation

  Ho – Higher egg mortality related to longer periods of redd inundation
- Estimate potential "take" (if possible)
- Define causal mechanisms of take
- Integrate results into "risk-averse" operational plan

In-situ egg survival study

- Remote spawning of bull trout
- Artificial redds constructed within zone of reservoir influence
- Monitor redds and "controls" for survival and emergence
- Collect ancillary data
  - Sediment
  - Water temperature
  - DO
- Comparisons of Survival to emergence (STE) vs Days of inundation

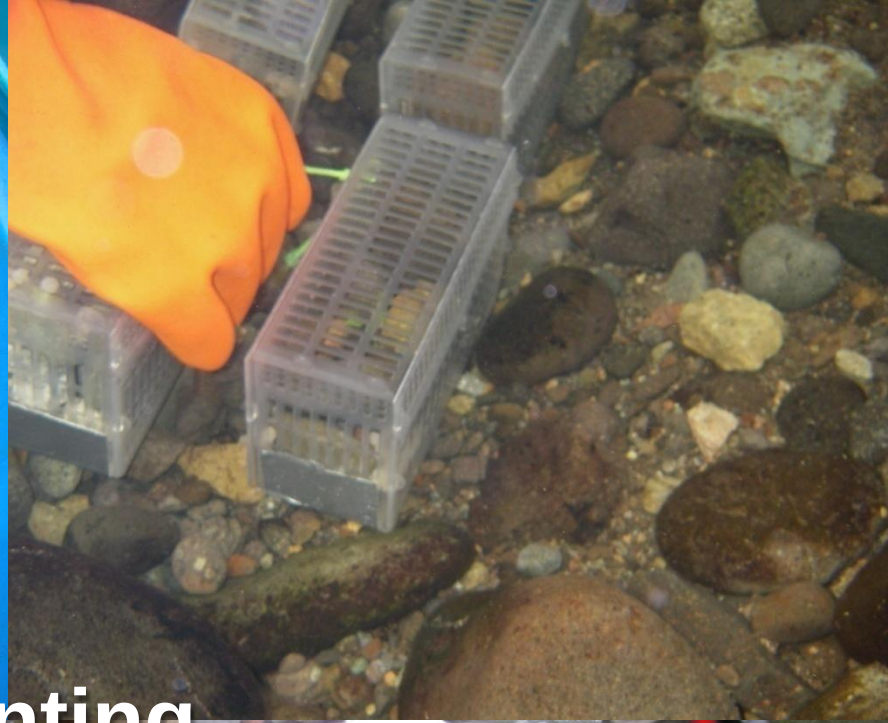
Capture

Spawn – Fertilize – Water Harden

Fish stats

- Cedar River
  - 5 females spawned (400-528 mm FL)
  - 2 males (460-520 mm FL)
- Rex River
  - 5 females spawned (453-563 mm FL)
  - 1 male (546mm FL)
- Weights – range 650 – 1500 gm

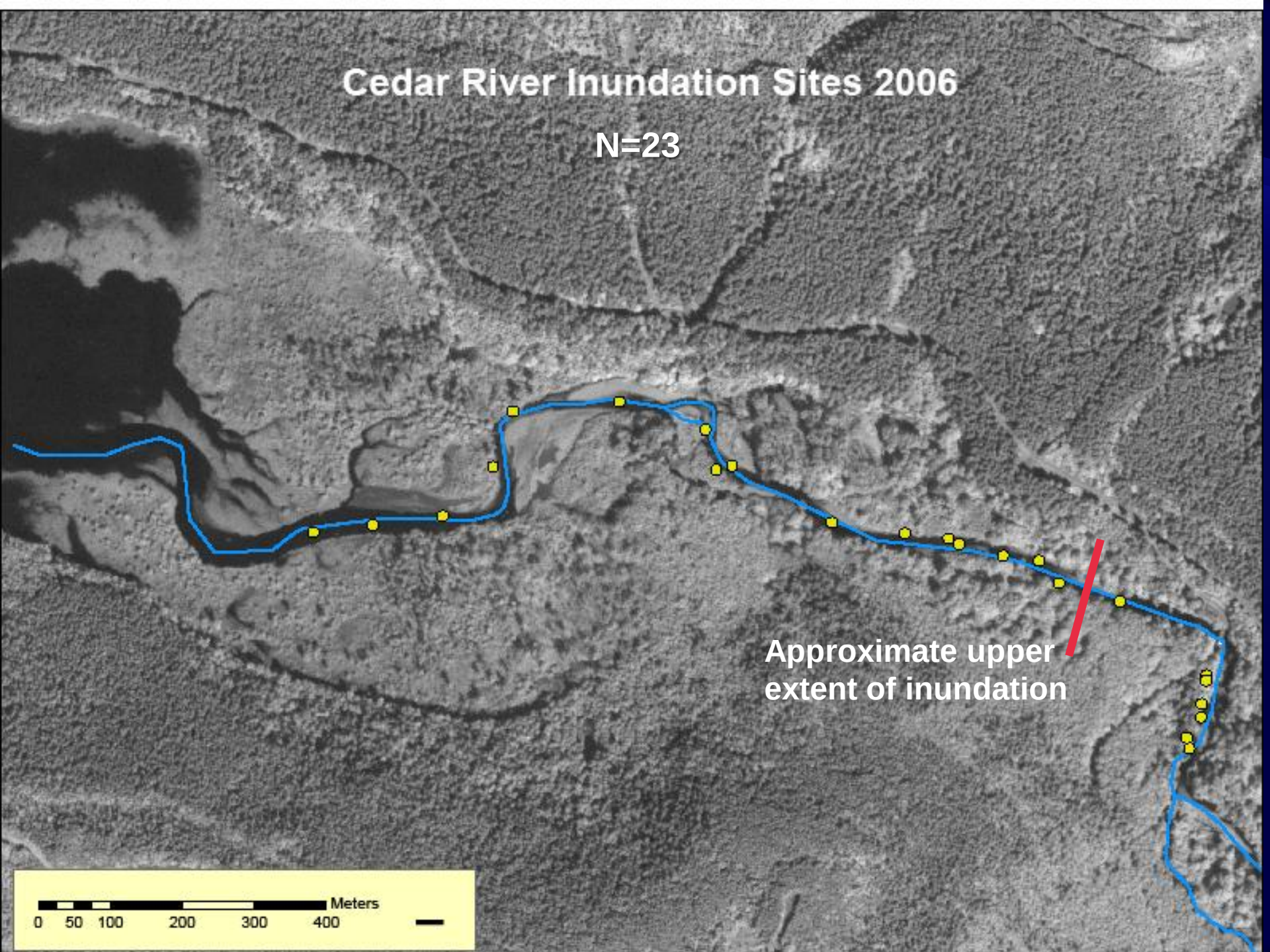
Egg Planting

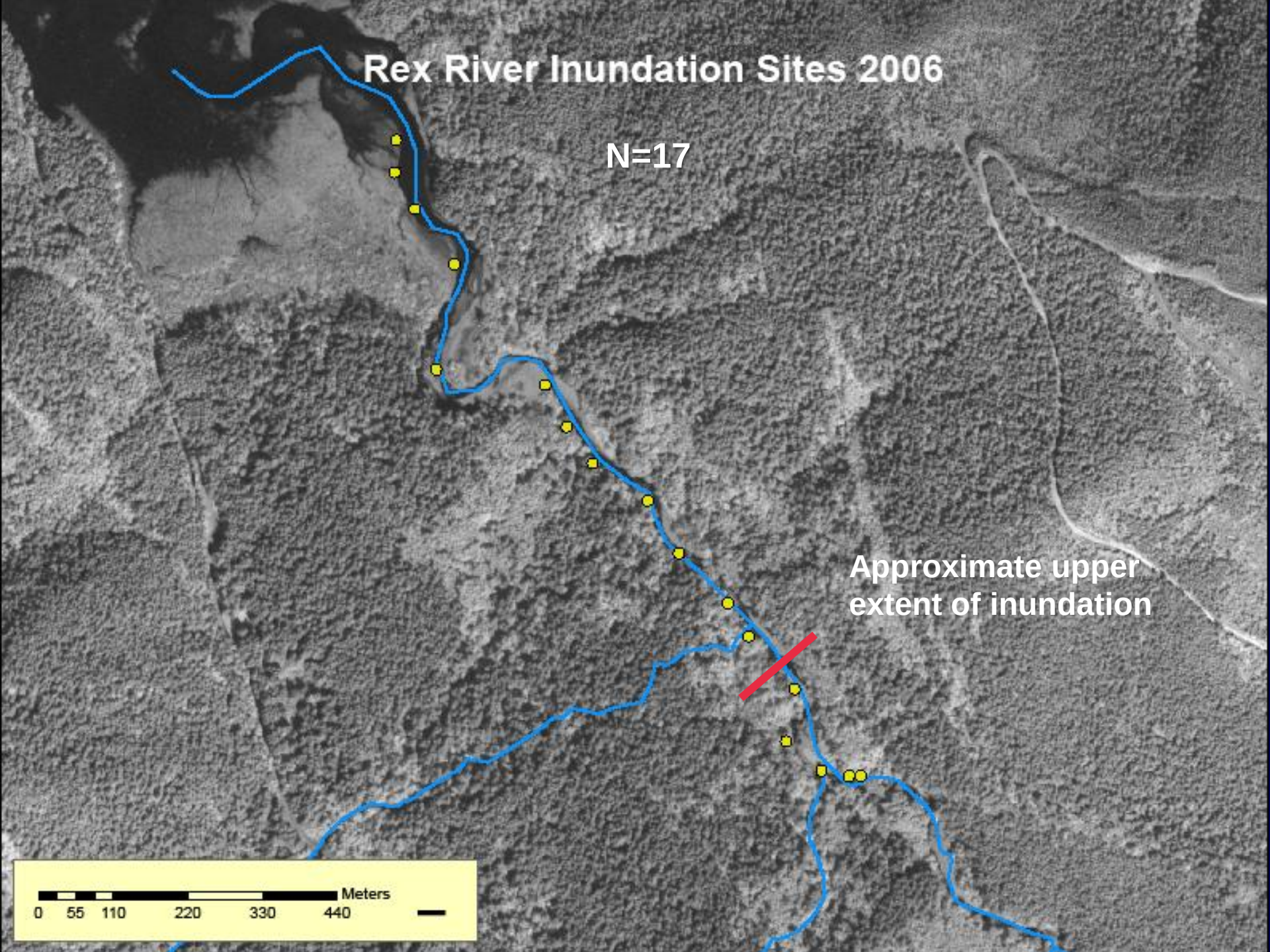


Egg chambers = Whitlock – Vibert boxes

- Filled with clean gravel
- Duct tape on bottom
- 50 embryos per box

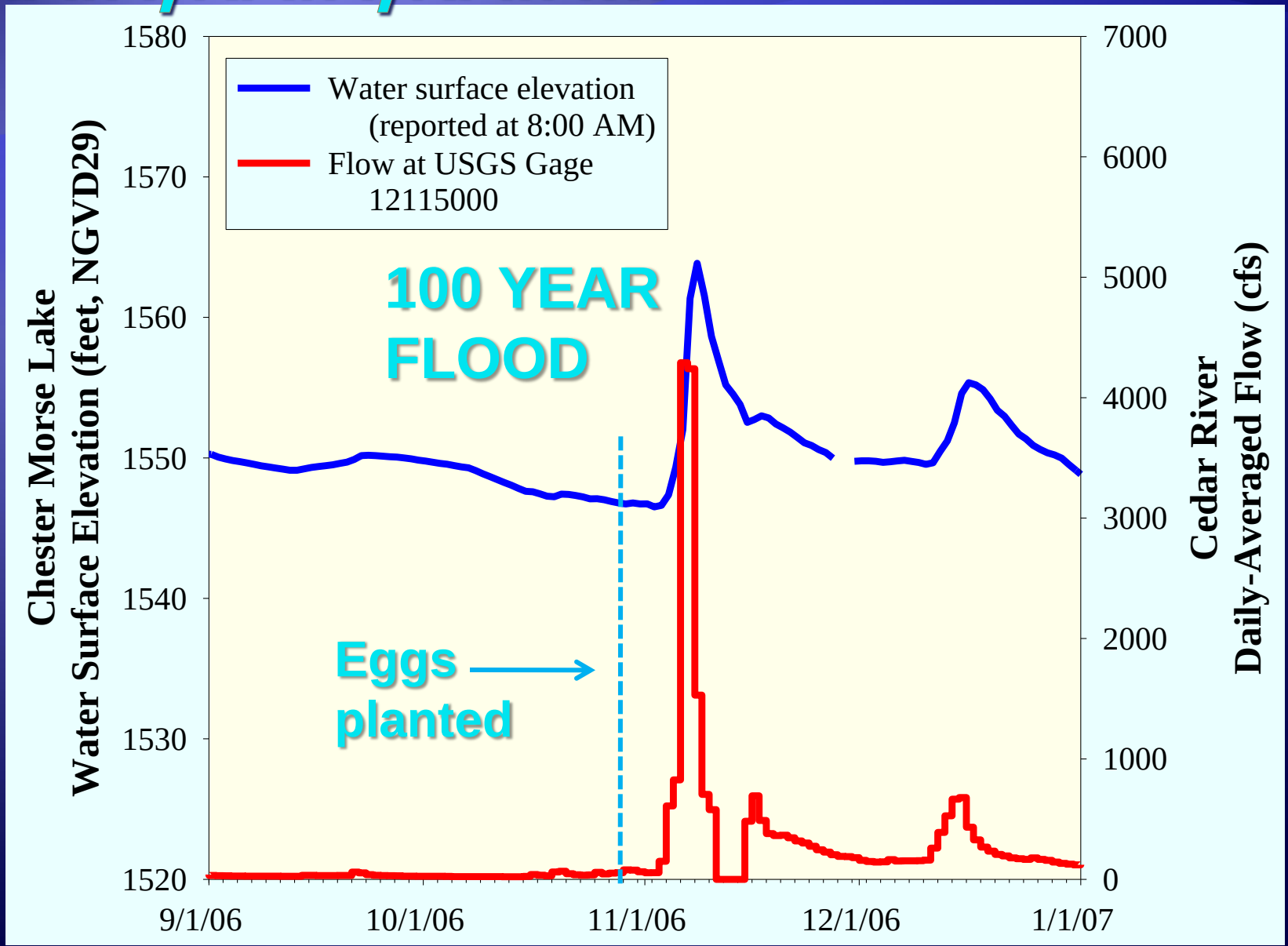
- 4 boxes per redd
- Colored string attached for relocation


Cedar River Inundation Sites 2006
N=23
Approximate upper extent of inundation
Meters
0 50 100 200 300 400


Rex River Inundation Sites 2006
N=17
Approximate upper extent of inundation
Meters
0 55 110 220 330 440

CONTROLS

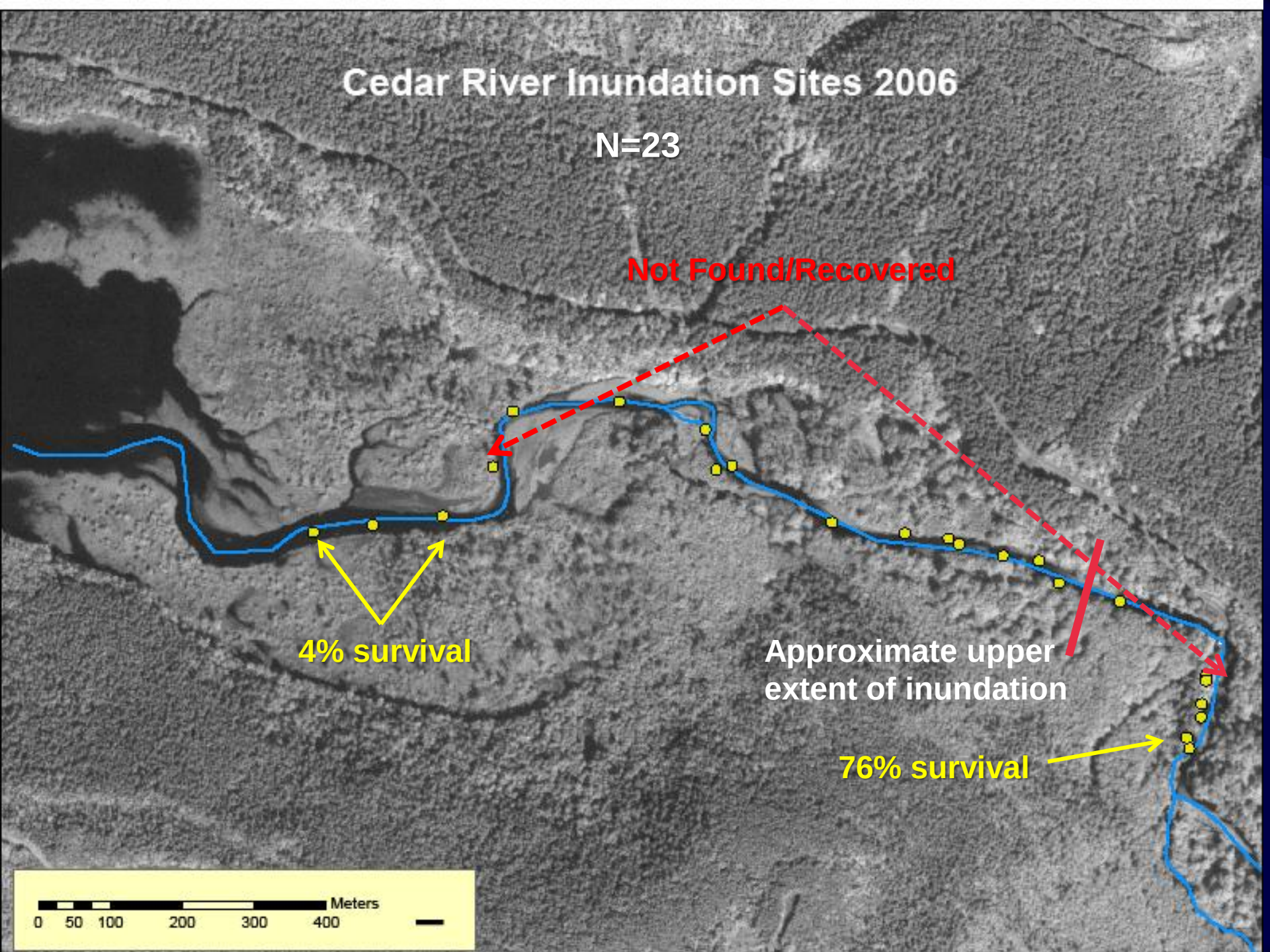
And then Mr. Murphy showed up – RAIN,RAIN,RAIN…

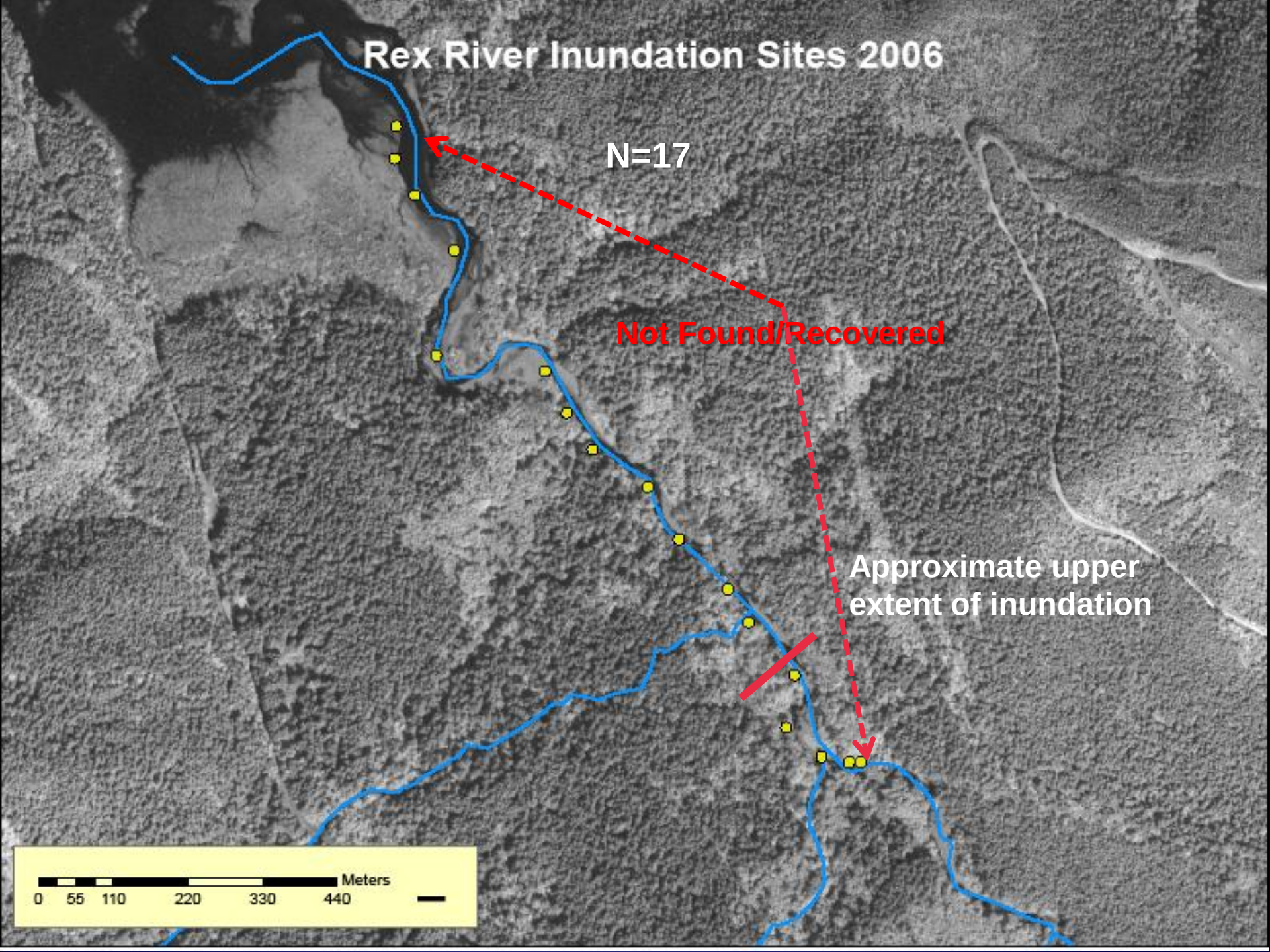


Effects

- Scour and dislodgement
- Deposition and covering
- Channel re-alignment

TESTS COMPROMISED


Cedar River Inundation Sites 2006
N=23
Not Found/Recovered
4% survival
Approximate upper
extent of inundation
76% survival
Meters
0 50 100 200 300 400


Rex River Inundation Sites 2006
N=17
Not Found/Recovered
Approximate upper extent of inundation
Meters
0 55 110 220 330 440

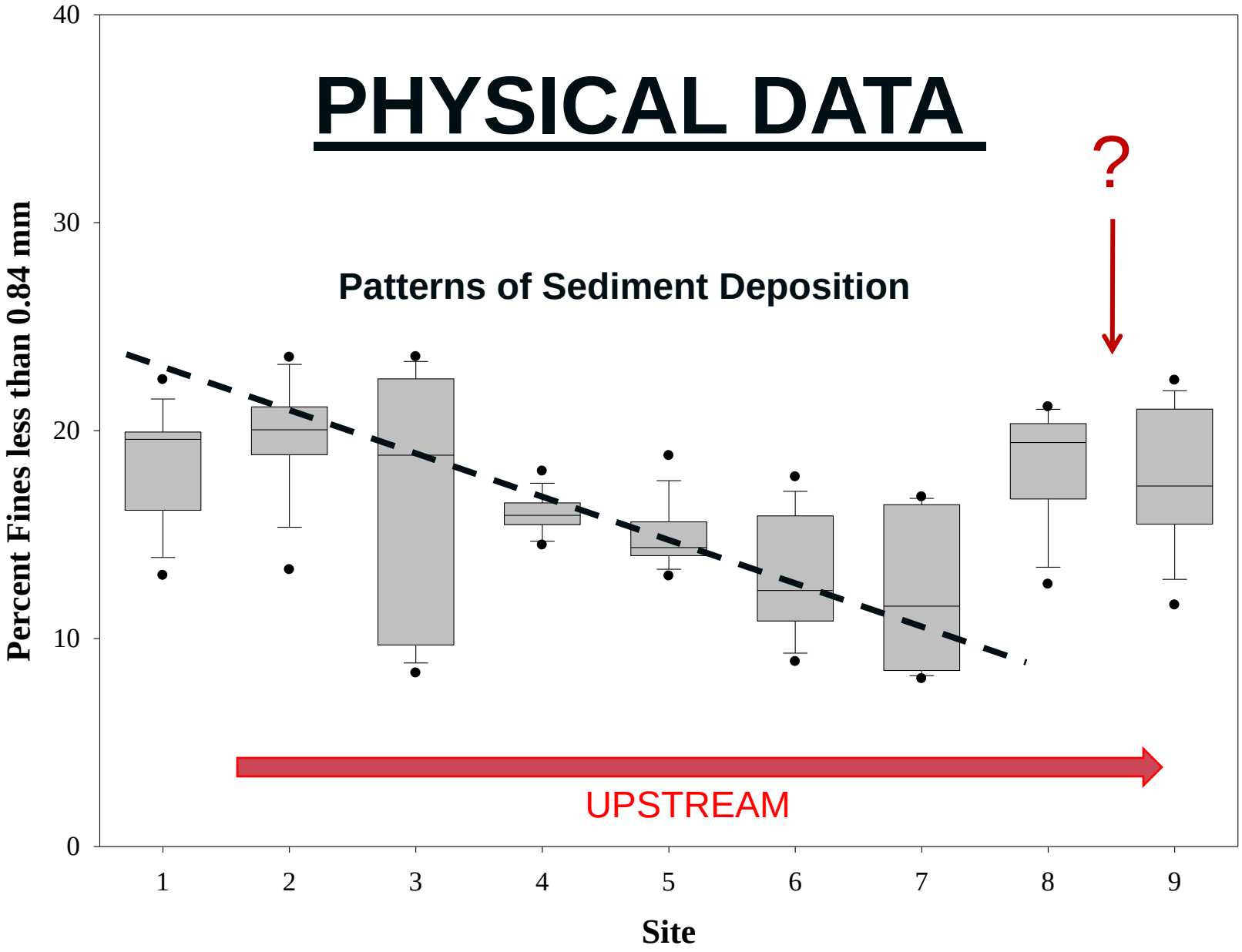
PRELIMINARY POSTULATES:

- Observations
- Some physical data
- Some biological data

OBSERVATIONS

Surficial sediment deposition noticeable at reservoir – river interface

PHYSICAL DATA



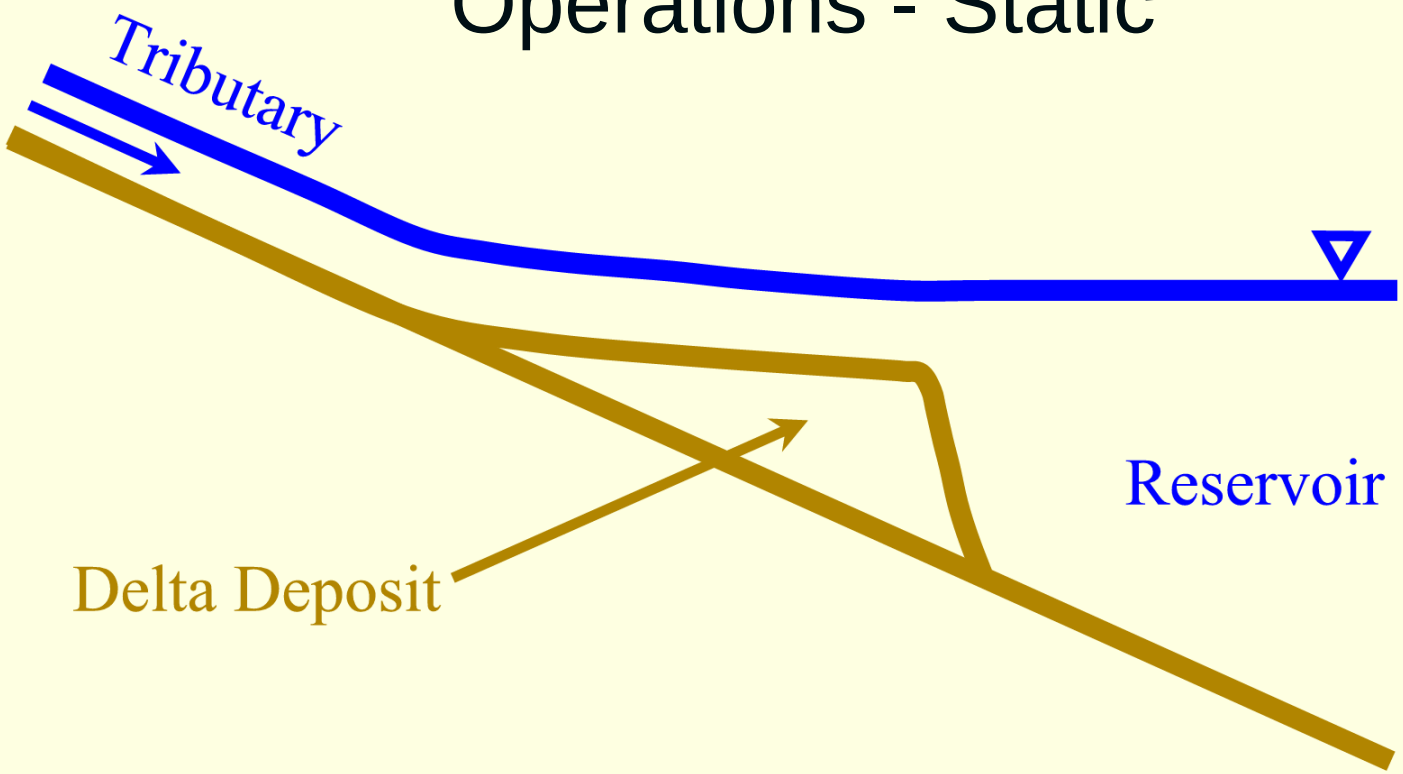
BIOLOGICAL DATA

(yes it is limited): spatial difference in survival

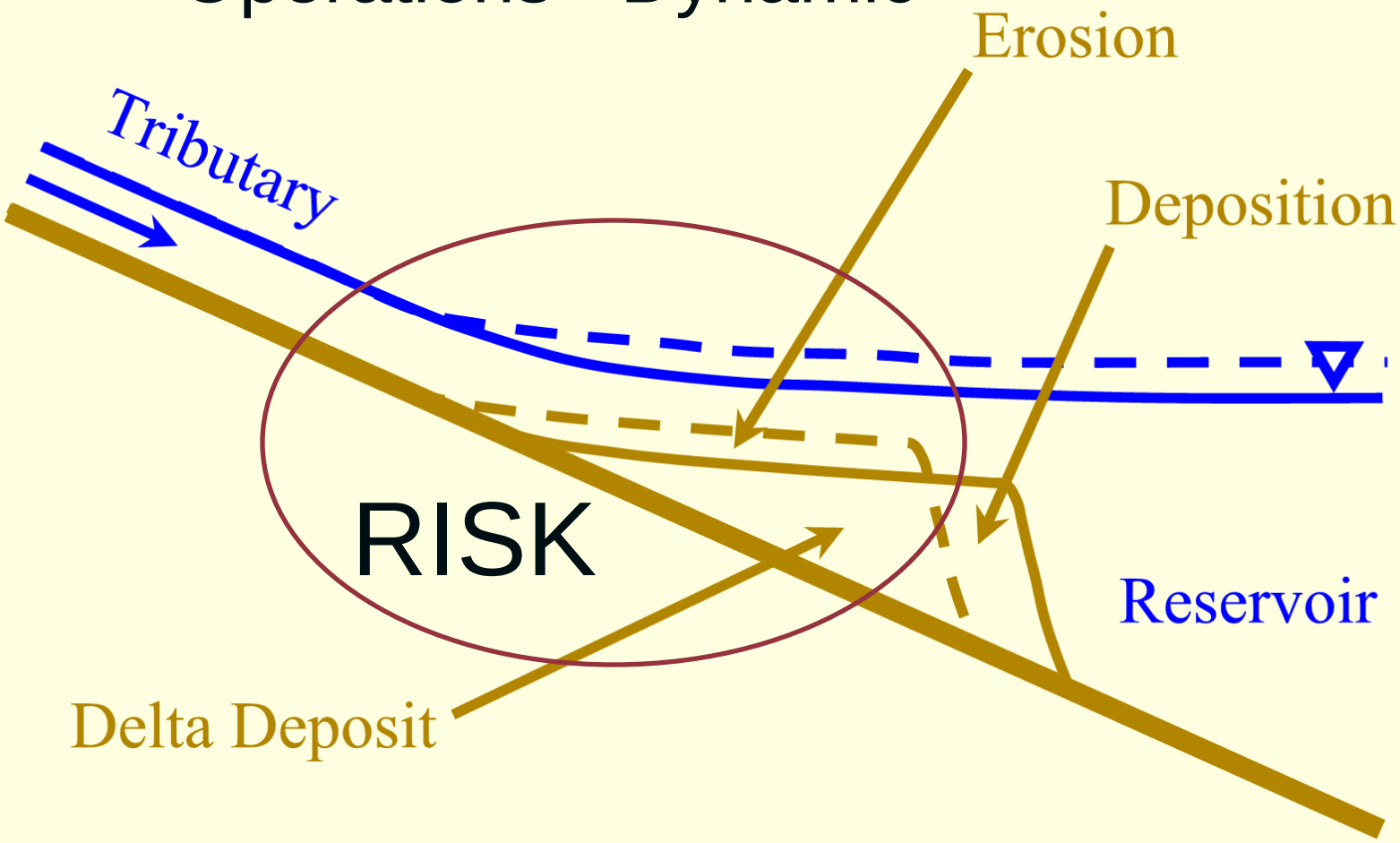
- Riverine - Low sediment levels = high egg survival

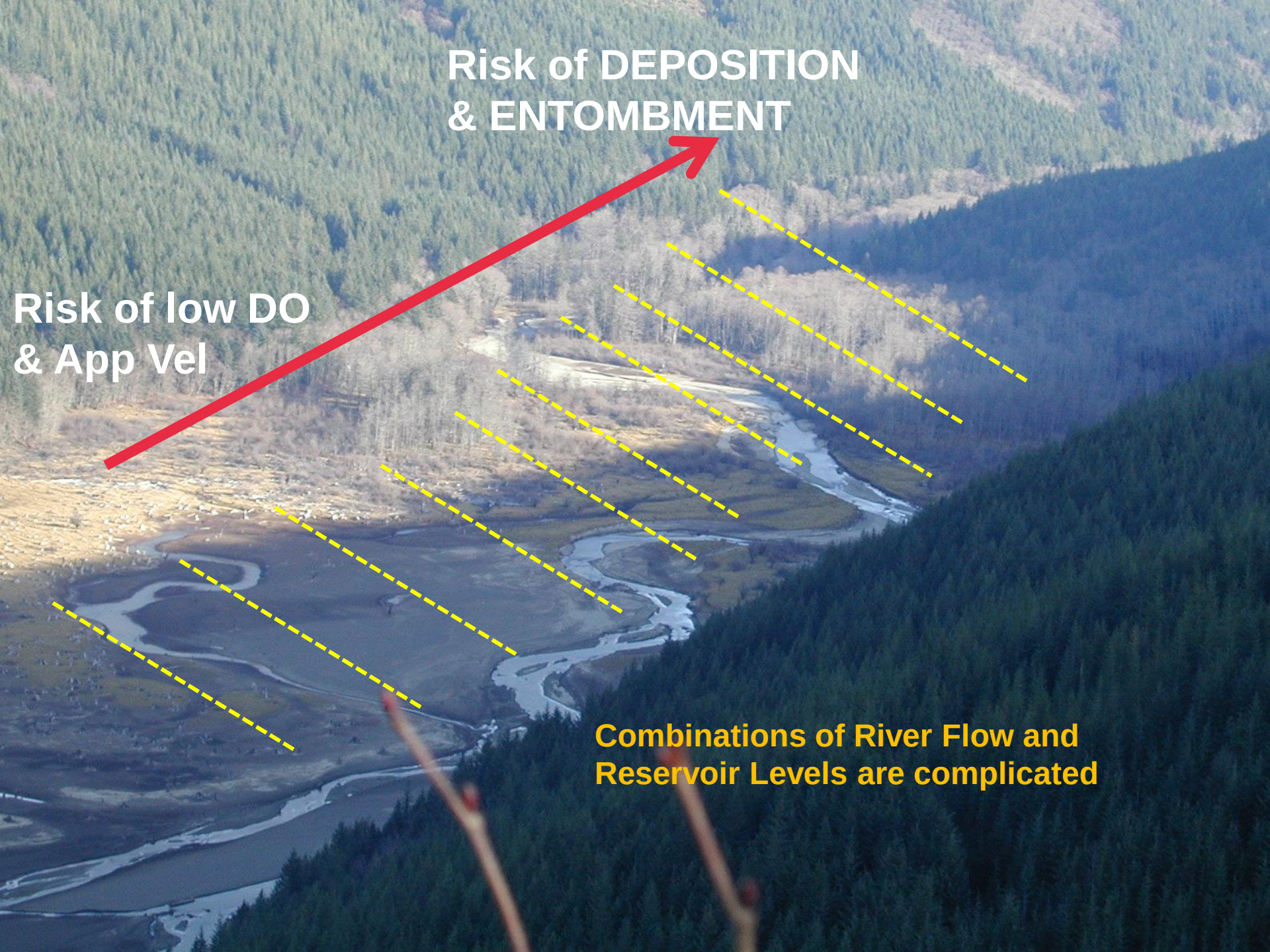
- Lacustrine - High sediment levels = low egg survival

Operations - Static

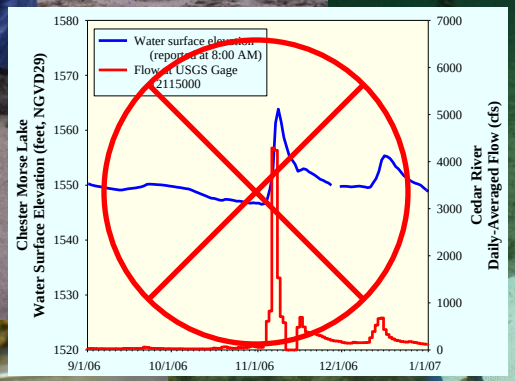


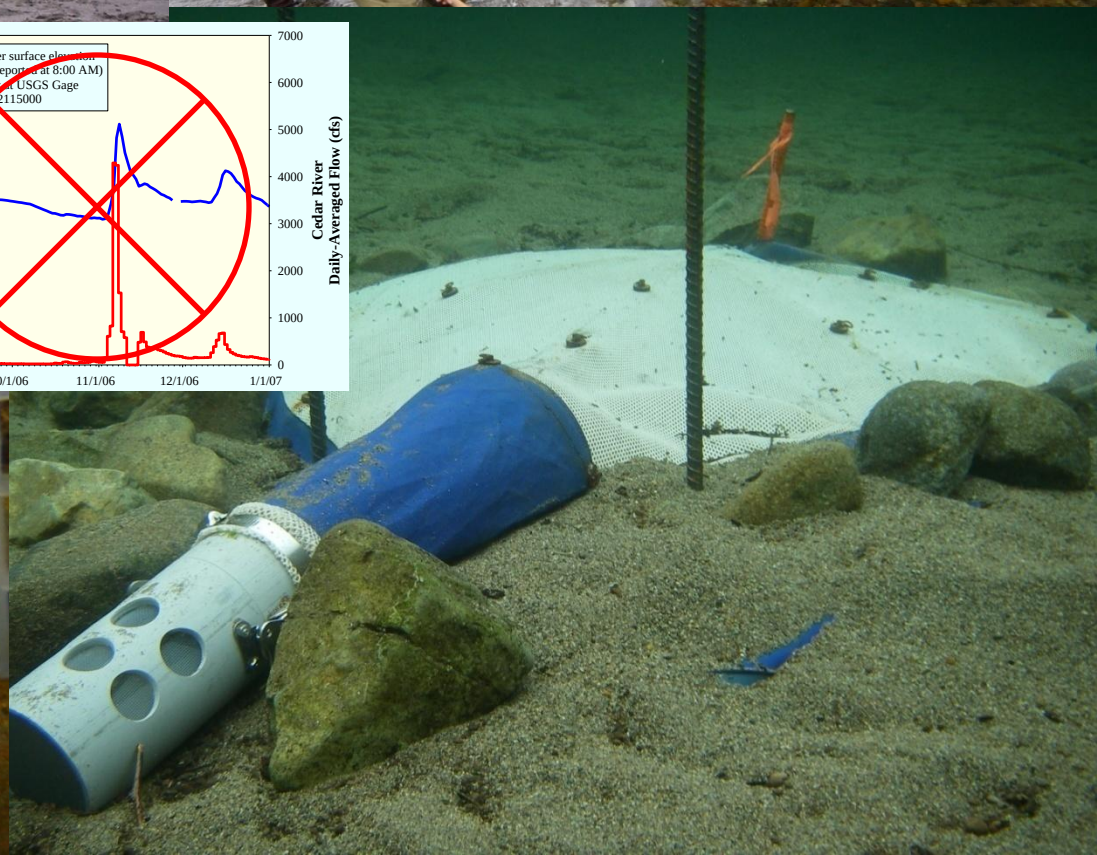
Operations - Dynamic




Risk of DEPOSITION
& ENTOMBMENT
Risk of low DO
& App Vel
Combinations of River Flow and
Reservoir Levels are complicated

ANOTHER YEAR OF STUDY






QUESTIONS